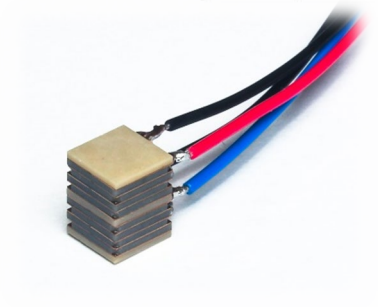
Shear Actuators

Shear Stack Actuators

Features

- Displacement up to 6 µm
- Operating voltage +/-320V
- X, XY or XYZ combined motion
- Very high stiffness for short response times (<1ms)
- Low capacitance
- Available in two cross-sections, 5*5 and 10*10mm



Applications

- Micro- and nanopositioning
- Laser systems
- Optical fiber scanning
- Scanning Probe Microscopy

Description

CTS piezoelectric shear actuators are ideal for a wide range of electronic designs requiring precise and fast movement. CTS shear stack actuators feature very high displacement at low operating voltages. Multiaxial actuators are available for independent motion in 2 or 3 directions.

Standard Product, add-ons or Custom Solution

This document contains information about the CTS standard shear stack actuators and available add-ons. All the CTS standard products can be custom designed to match specific requirements – find more information on www.ctscorp.com or contact your local sales representative.

Specifications

Product series	NAC2402-HXX	NAC2403-HXX	NAC2902-HXX	NAC2903-HXX	Unit
Shear motion axes	X		X-Y		-
Length (L)	5 +/-0.3	10 +/-0.4	5 +/-0.3	10 +/-0.4	mm
Width (W)	5 +/-0.3	10 +/-0.4	5 +/-0.3	10 +/-0.4	mm
Height (H)	1.7 to 3.4*		2.8 to 6.4*		mm
Operating voltage, V_{max}	320**				V
Max. operating temp.	150				°C
PZT material	NCE51				-
Electrode material	Gold on Nickel				-
Interconnection electrodes	Copper-Beryllium				

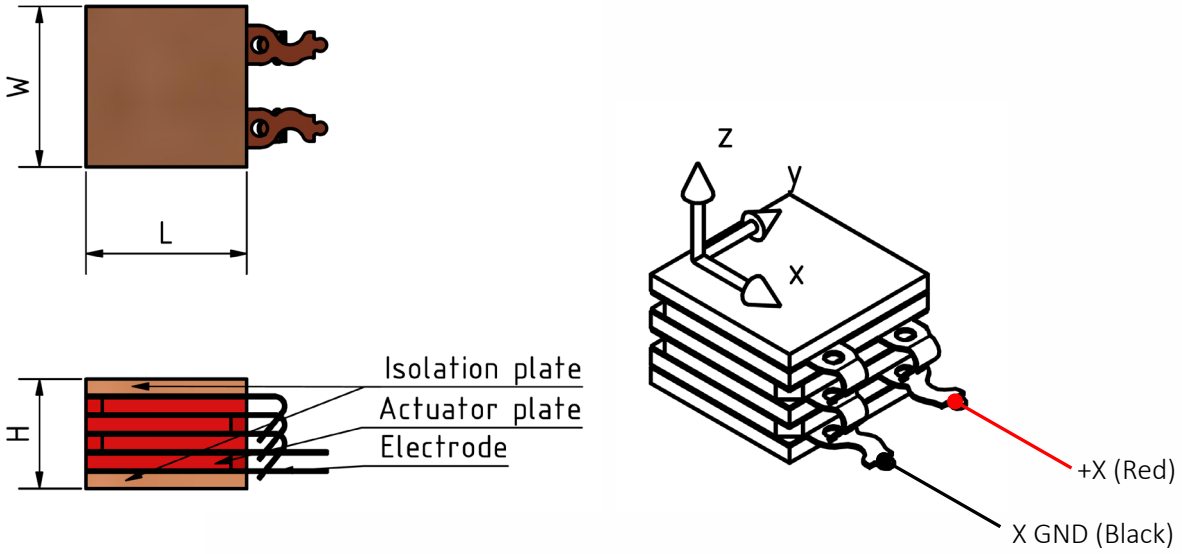
* See the different height options and the corresponding free displacement and capacitance data in the tables below.
** Operating voltage at room temperature. Voltage has to be reduced at elevated temperature

Product series	NAC3402-HXX	NAC3403-HXX	Unit
Motion axes	X-Y-Z		-
Length (L)	5 +/-0.3	10 +/-0.4	mm
Width (W)	5 +/-0.3	10 +/-0.4	mm
Height (H)	7.4 to 12.6*	7.4 to 21.3*	mm
Operating voltage, V_{max}	320**		V
Max. operating temp.	150		°C
PZT material	NCE51		-
Electrode material	Gold on Nickel		-
Interconnection electrodes	Copper-Beryllium		

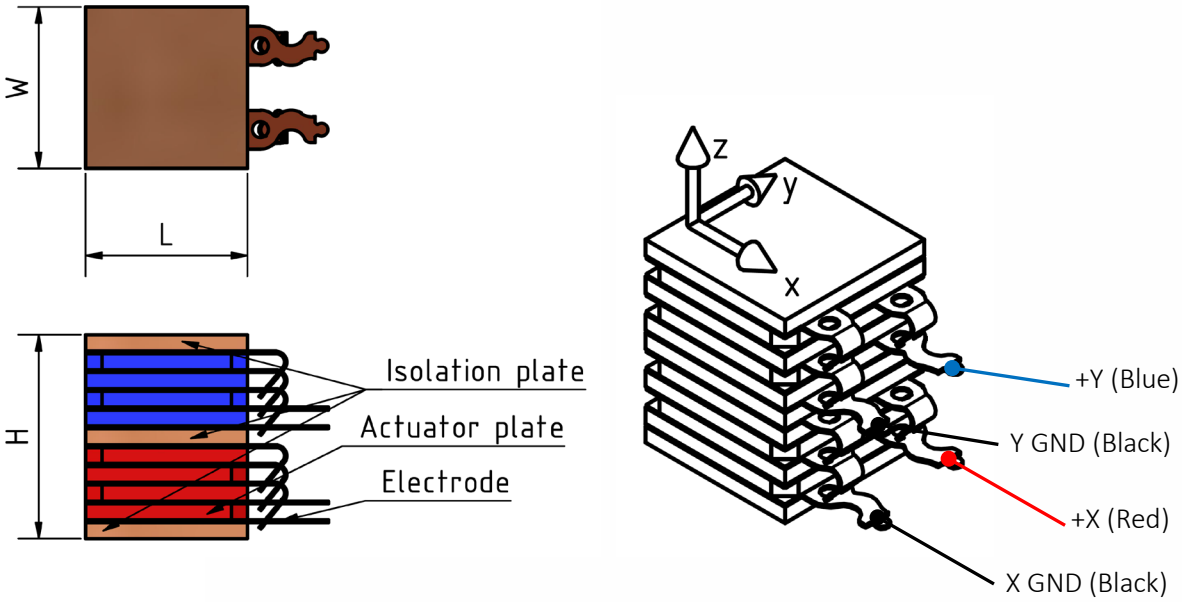
* See the different height options and the corresponding free displacement and capacitance data in the tables below.
** Operating voltage at room temperature. Voltage has to be reduced at elevated temperature
This product contains materials that present health hazards by inhalation or ingestion. Do not attempt to disassemble, grind or melt the product and dispose of according to local regulations.

Drawing (first angle projection)

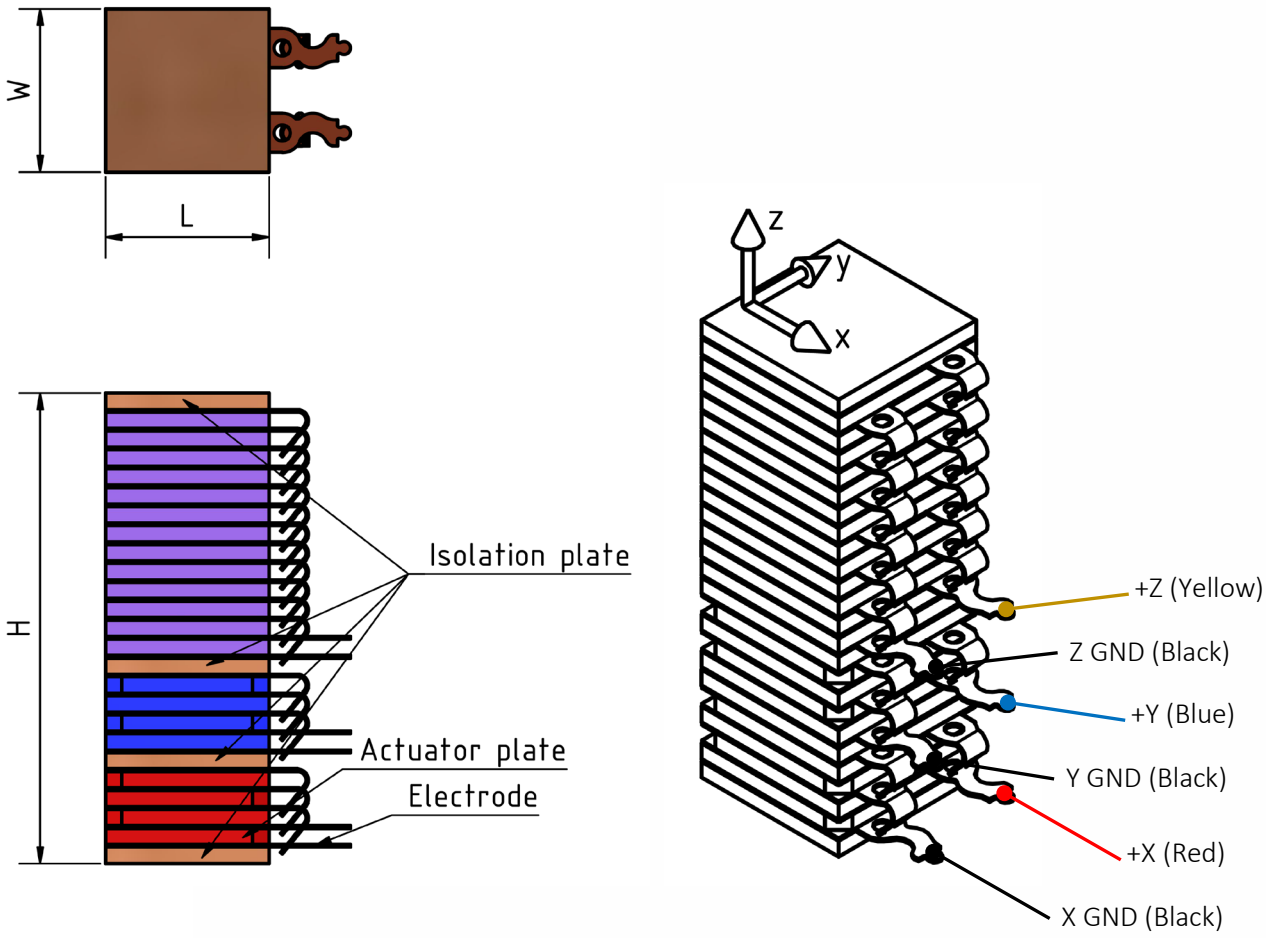
For NAC2402-HXX and NAC2403-HXX series (X motion):



For NAC2902-HXX and NAC2903-HXX series (X-Y motion):



For NAC3402-HXX and NAC3403-HXX series (X-Y-Z motion):



Mounting, Connecting and Driving

Please refer to our online tutorials for recommendations about mounting, connecting and driving shear stack actuators.

Stacking Options

For NAC2402-HXX series:

Product series	NAC2402-HXX			
Height H	Product Reference	Free Stroke	Capacitance	Shear stiffness
+/-0.2 mm		+/-15%	+/-15%	Typ.
mm		µm	nF	N/µm
1.7	NAC2402-H1.7	1.5	0.8	340
2.3	NAC2402-H2.3	3.0	1.7	250
3.4	NAC2402-H3.4	6.0	3.3	170

For NAC2403-HXX series:

Product series	NAC2403-HXX			
Height H	Product Reference	Free Stroke	Capacitance	Shear stiffness
+/-0.2 mm		+/-15%	+/-15%	Typ.
mm		µm	nF	N/µm
1.7	NAC2403-H1.7	1.5	3.3	1350
2.3	NAC2403-H2.3	3.0	6.6	1000
3.4	NAC2403-H3.4	6.0	13.3	680

For NAC2902-HXX series:

Product series	NAC2902-HXX			
Height H	Product Reference	Free Stroke X*Y	Capacitance X*Y	Shear stiffness
+/-0.2 mm		+/-15%	+/-15%	Typ.
mm		µm	nF	N/µm
2.8	NAC2902-H2.8	1.5*1.5	0.8*0.8	200
4.0	NAC2902-H4.0	3.0*3.0	1.7*1.7	140
6.4	NAC2902-H6.4	6.0*6.0	3.3*3.3	90

For NAC2903-HXX series:

Product series	NAC2903-HXX			
Height H	Product Reference	Free Stroke X*Y	Capacitance X*Y	Shear stiffness
+/-0.2 mm		+/-15%	+/-15%	Typ.
mm		µm	nF	N/µm
2.8	NAC2903-H2.8	1.5*1.5	3.3*3.3	830
4.0	NAC2903-H4.0	3.0*3.0	6.6*6.6	580
6.4	NAC2903-H6.4	6.0*6.0	13.3*13.3	360

For NAC3402-HXX series:

Product series	NAC3402-HXX			
Height H	Product Reference	Free Stroke X*Y*Z	Capacitance X*Y*Z	Shear stiffness
		+/-15%	+/-15%	Typ.
mm		µm	nF	N/µm
7.4 +/-0.2	NAC3402-H7.4	1.5*1.5*1.5	0.8*0.8*5.5	75
12.6 +/-0.3	NAC3402-H12.6	3.0*3.0*3.0	1.7*1.7*11.1	45

For NAC3403-HXX series:

Product series	NAC3403-HXX			
Height H	Product Reference	Free Stroke X*Y*Z	Capacitance X*Y*Z	Shear stiffness
+/-0.2 mm		+/-15%	+/-15%	Typ.
mm		µm	nF	N/µm
7.4 +/-0.2	NAC3403-H7.4	1.5*1.5*1.5	3.3*3.3*21.4	310
12.6 +/-0.3	NAC3403-H12.6	3.0*3.0*3.0	6.6*6.6*42.7	180
23.1 +/-0.4	NAC3403-H23.1	6.0*6.0*6.0	13.3*13.3*85.4	100

Add-ons

Wire Options

When ordering actuators from CTS, it is possible to have wires fitted to facilitate integration. For the selection of a wire for connection, these parameters must be considered:

- Operation voltage
- Intensity of current
- Operating temperature
- Environment for example vacuum

We recommend wires with PTFE insulation

PTFE wires can stand temperatures above 200 °C, whereas PVC wires only resist temperatures up to 80 °C. We recommend PTFE for the thermal and chemical resistance of the insulation.

For vacuum and cryogenic applications, we recommend Kapton wires, which offer superior outgassing properties and flexibility.

Standard wire option for shear stack actuators

One standard wire option is available:

	Option A01
Wire type	MIL-W-16878/4, 28 AWG, 7 strands
Length	200mm +/-10mm
Position	On electrode tabs (see drawing)
Orientation	Perpendicular to height

Standard wire option A01 has a temperature rating of 150°C.

Customized wire option for shear stack actuators

We stock several alternative wire types:

Wire type	Voltage rating [V]	Approx. outer diameter [mm]	Rec. max. current [A]	Min. operating temperature [°C]
32AWG, MIL-W-16878/6, 7 strands	250	0.6	0.53	-60
30AWG, MIL-W-16878/4, 7 strands	600	0.8	0.86	-60
28AWG, MIL-W-16878/4, 7 strands	600	0.9	1.4	-60
28AWG, Allectra 301-KAPM-035 (Kapton insulation, UHV)	7500*	0.6	1.0	-269
22AWG, BS3G210 Type A, 19 strands	300	1.1	8	-75

* In vacuum conditions

As part of our custom program, we can also stock specific wire.

UHV preparation

Ultra high vacuum (UHV) is the vacuum regime characterized by pressures lower than about 10^{-7} pascal or 100 nanopascals (~10^{-9} torr). Extreme cleanliness and low outgassing are essential parameters in sustaining the vacuum level in such systems. Elevated temperature compatibility is often needed since water vapor and other trace gasses are removed from the system during a "bake-out".

CTS piezoceramic components are designed to support system development and integration of piezo technology in UHV applications. Among many technical capabilities, CTS is competent in producing piezoelectric actuators meeting the demands on temperature compatibility and out gassing levels set by UHV operation.

For low outgassing, Kapton-insulated wires are recommended. In addition, with the UHV preparation the products will undergo a specific cleaning process and be packaged in sealed pouches.

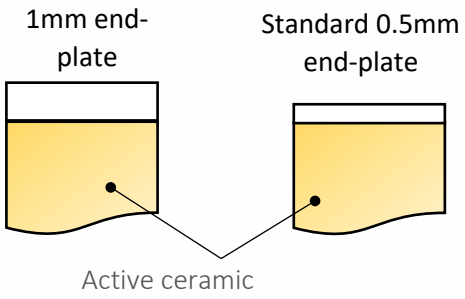
Non-magnetic design

Although piezoelectric ceramic and all accessories are non-magnetic, our shear stack actuators include a thin layer of Nickel under the gold electrodes. This can be a concern when shear stacks are applied in experiments where a homogeneous magnetic field or very accurate magnetic field measurements are required. If this is the case, CTS can provide special shear stacks that do not include Nickel.

End-plates

As a standard, shear stacks are supplied with 0.5mm thick ceramic end-plates. All our standard end-plates are produced with our piezoceramic material NCE51. Ceramic provides ideal electrical insulation properties, low thermal expansion mismatch as well as good mechanical properties to spread the load over the surface of the active piezoceramic. For shear stacks, a thickness of 0.5mm is sufficient for a good spread of the load.

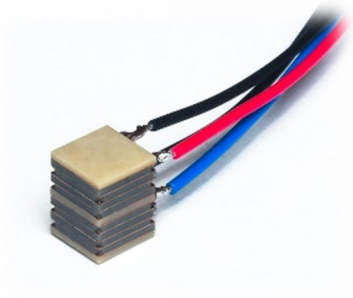
It is nevertheless possible to apply thicker end-plates, for example if a longer isolation distance is required. This is illustrated below:



It is not possible to produce shear stacks without end-plates, as it would expose the live electrodes.

Shear Actuators Product Families

Shear Plate Actuators



Shear Stack Actuators:

- X
- XY
- XYZ

Learn more about the different actuator product families on www.ctscorp.com.